Environmentally explicit stock-recruitment relationships in Witch Flounder

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Introduction

The relationship between temperature and recruitment was examined per Terms of Reference 3 *Investigate effects of environmental factors and climate change on recruitment, growth and natural mortality of witch flounder. If quantifiable relationships are identified, consider incorporating these into the stock assessment*

Methods

Recruitment was derived from preliminary ASAP model runs. Three preliminary model runs were examined: Run 9 uses all survey indices (NEFSC, ASMFS, and MENH); Run 10 includes LPUE; Run 15 explores uncertainty in catch.

Fall bottom temperatures were derived from the deeper portions of the Gulf of Maine using temperature observations made on the fall trawl survey.

Environment-recruitment relationships were conducted per Hare et al. (2015).

The underlying hypothesis examined was that fall temperature determine the amount of available juvenile habitat and warmer temperature reduces available habitat and recruitment (*sensu* Miller et al. 2016).

Assumptions: The recruitment provided in the ASAP model output is for Age 1 fish and that recruitment in the model output lagged by 1 year would align with the year of spawning and the corresponding SSB.

Results and Discussion

Based on the analyses conducted, there was no evidence of temperature influencing recruitment (Figures 1-3).

In general, recruitment was high at low spawning stock biomasses and exhibited no relationship with temperature. Steepness in all model runs was quite high – approaching or equaling 1. The Beverton Holt relationship without environment had the lowest AICc score for all three model runs.

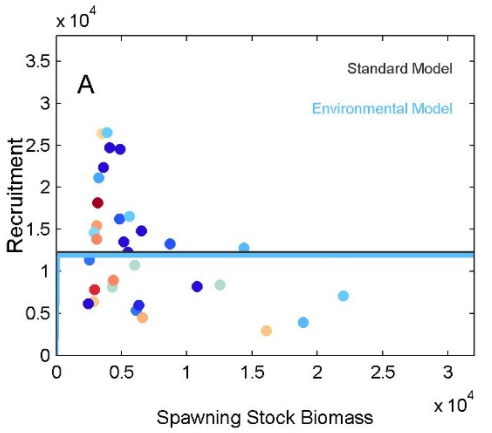
The shape of the recruitment data suggests that a Ricker stock-recruitment relationship may be appropriate, but the density dependence of such a function would be quite high (depressing recruitment at high spawning stock biomasses).

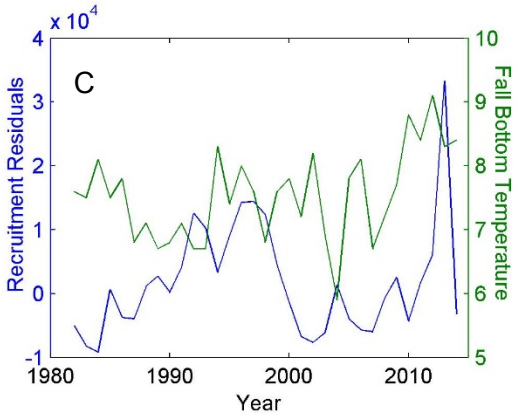
References

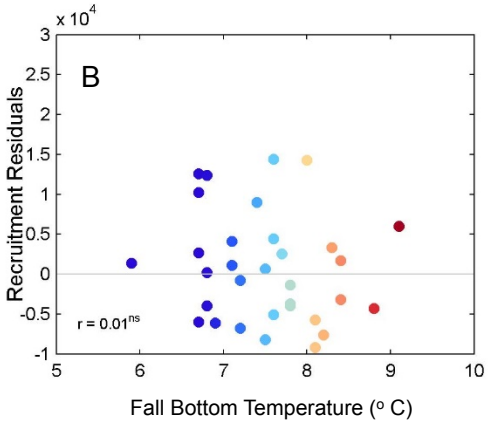
Hare, J. A., Brooks, E. N., Palmer, M. C., & Churchill, J. H. (2015). Re-evaluating the effect of wind on recruitment in Gulf of Maine Atlantic Cod (Gadus morhua) using an environmentally-explicit stock recruitment model. Fisheries Oceanography, 24(1), 90-105.

Miller, T. J., Hare, J. A., & Alade, L. A. (2016). A state-space approach to incorporating environmental effects on recruitment in an age-structured assessment model with an application to southern New England yellowtail flounder. Canadian Journal of Fisheries and Aquatic Sciences, 73(999), 1-10.

Figure 1. Standard (black line) and environmentally-explicit (cyan line) stock-recruitment analyses for ASAP Model Output 09 (A). The environmentally-explicit model fit (B) and relationship with recruitment residuals (C) for the Gulf of Maine Fall mean bottom water temperature.







Model 09

Standard Model AICc = 606.62

Environmental Model AICc = 615.37

Figure 2. Standard (black line) and environmentally-explicit (cyan line) stock-recruitment analyses for ASAP Model Output 10 (A). The environmentally-explicit model fit (B) and relationship with recruitment residuals (C) for the Gulf of Maine Fall mean bottom water temperature.

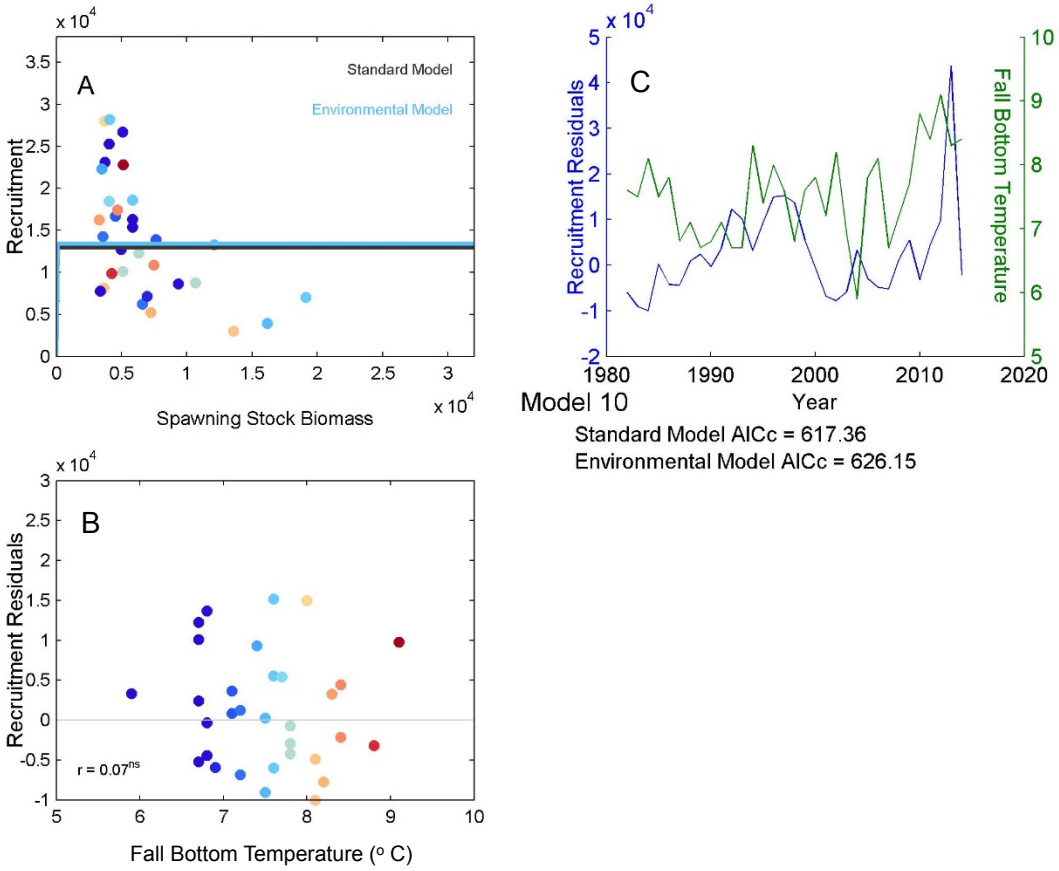
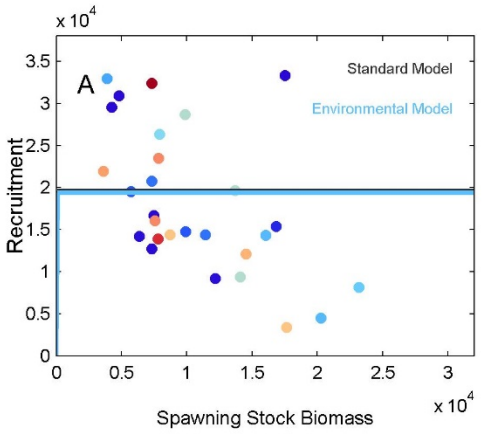
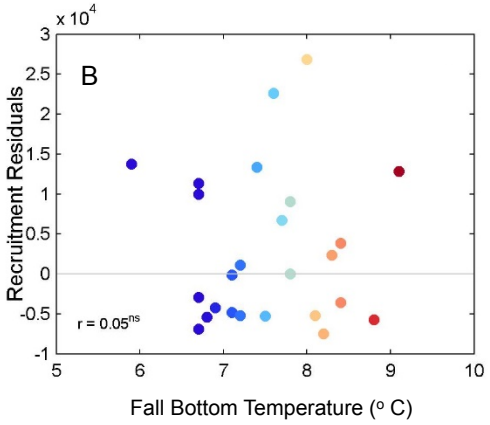
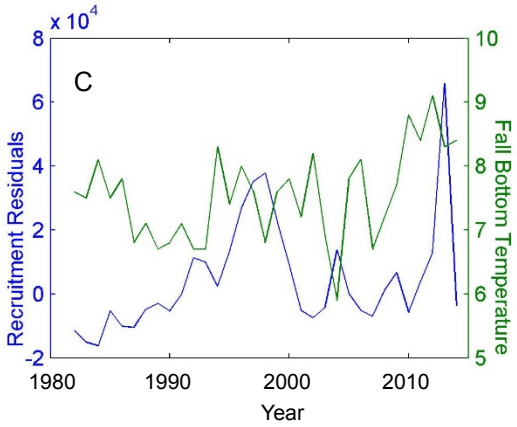


Figure 3. Standard (black line) and environmentally-explicit (cyan line) stock-recruitment analyses for ASAP Model Output 15 (A). The environmentally-explicit model fit (B) and relationship with recruitment residuals (C) for the Gulf of Maine Fall mean bottom water temperature.







Model 15

Standard Model AICc = 652.28

Environmental Model AICc = 655.15